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THE IMPORTANCE OF TRACE ELEMENTS IN SOMATIC DISEASES IN CHILDREN

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Abstract. In early childhood (from 1 month to 3 years of age), somatic diseases (iron deficiency anemia, rickets, delayed growth and development, immune disorders) are often associated with deficiencies of micro- and macroelements — copper (Cu), zinc (Zn), iron (Fe), calcium (Ca), and phosphorus (P). This article examines the role of these elements in the body of young children, as well as the causes and consequences of their deficiency. In a study conducted by the authors, serum levels of Cu, Zn, Fe, Ca, and P were investigated in 110 children aged 1 month to 3 years with somatic diseases (iron deficiency anemia, rickets, recurrent respiratory infections, and developmental delay) and in 50 healthy children in the control group. The results revealed a high prevalence of Zn and Fe deficiency, excess Cu, and imbalance in the Ca/P ratio in affected children.

Keywords: early childhood, somatic diseases, trace elements, copper, zinc, iron, calcium, phosphorus, deficiency.

Annotatsiya. Ilk bolalik davrida (1 oydan 3 yoshgacha) somatik kasalliklar (temir tanqisligi anemiyasi, raxit, o‘sish va rivojlanishning kechikishi, immun buzilishlar) ko‘pincha mikro va makroelementlar — mis (Cu), rux (Zn), temir (Fe), kalsiy (Ca) va fosfor (P) yetishmovchiligi bilan bog‘liq bo‘ladi. Ushbu maqolada ushbu elementlarning yosh bolalar organizmidagi o‘rni, shuningdek, ularning yetishmovchiligi sabablari va oqibatlari ko‘rib chiqiladi. Mualliflar tomonidan o‘tkazilgan tadqiqotda somatik kasalliklar (temir tanqisligi anemiyasi, raxit, retsidivlanuvchi respirator infeksiyalar, rivojlanishdan orqada qolish) bilan og‘rigan 1 oylikdan 3 yoshgacha bo‘lgan 110 nafar va nazorat guruhidagi 50 nafar sog‘lom bolalarda qon zardobidagi Cu, Zn, Fe, Ca va P miqdori o‘rganildi. Natijalar shuni ko‘rsatdiki, kasallangan bolalarda Zn va Fe tanqisligi, Cu ortiqchaligi va Ca/P nisbatining buzilishi yuqori darajada tarqalgan.

Kalit so‘zlar:Ilk bolalik, somatik kasalliklar, mikroelementlar, mis, rux, temir, kalsiy, fosfor, yetishmovchilik.

Аннотация. В раннем детском возрасте (от 1 месяца до 3 лет) соматические заболевания (железодефицитная анемия, рахит, задержка роста и развития, иммунные нарушения) часто связаны с дефицитом микро- и макроэлементов — меди (Cu), цинка (Zn), железа (Fe), кальция (Ca) и фосфора (P). В данной статье рассматривается роль этих элементов в организме детей раннего

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возраста, а также причины и последствия их дефицита. В исследовании, проведенном авторами, уровень Cu, Zn, Fe, Ca и P в сыворотке крови был изучен у 110 детей в возрасте от 1 месяца до 3 лет с соматическими заболеваниями (железодефицитная анемия, рахит, рецидивирующие респираторные инфекции и задержка развития) и у 50 здоровых детей контрольной группы. Результаты выявили высокую распространенность дефицита Zn и Fe, избытка Cu и дисбаланса соотношения Ca/P у заболевших детей.

Ключевые слова: раннее детство, соматические заболевания, микроэлементы, медь, цинк, железо, кальций, фосфор, дефицит.

INTRODUCTION.

Early childhood (from 1 month to 3 years) is one of the most important and sensitive stages of human life. During this period, rapid growth of the body, brain development, formation of the immune system, and activation of all metabolic processes occur. Therefore, at this age, the presence of sufficient amounts of nutrients, in particular micro- and macroelements, is vital for the healthy development of the child. Microelements (zinc, iron, copper) and macroelements (calcium, phosphorus) play an important role in the composition of enzymes, hormone synthesis, immune response, hemoglobin formation, and bone mineralization.

According to the World Health Organization (WHO), in developing countries, 40-60% of children under 5 years of age suffer from iron deficiency anemia, 30-50% from zinc deficiency, and millions of children suffer from rickets. These conditions significantly impair not only physical development, but also cognitive and psycho-emotional development. In countries like Uzbekistan, micronutrient deficiencies remain a widespread problem due to short duration of breastfeeding, delayed or inadequate introduction of complementary feeding, and socio-economic factors.

Recent scientific studies show that micronutrient deficiencies at an early age cause not only somatic diseases (anemia, rickets, bronchopulmonary diseases), but also long-term consequences - mental retardation, persistent growth retardation, and susceptibility to chronic diseases. Therefore, the study of this problem and early diagnosis are relevant. This article presents the results of the authors' own study, which examined the levels of copper, zinc, iron, calcium, and phosphorus in children aged 1 month to 3 years in relation to somatic diseases.

Purpose of the study : The main purpose of this study is to study the role of micro- and macroelements of copper (Cu), zinc (Zn), iron (Fe), calcium (Ca) and phosphorus (P) in the development of somatic diseases in children aged 1 month to 3 years, to assess the serum levels of these elements in 110 sick children, and to

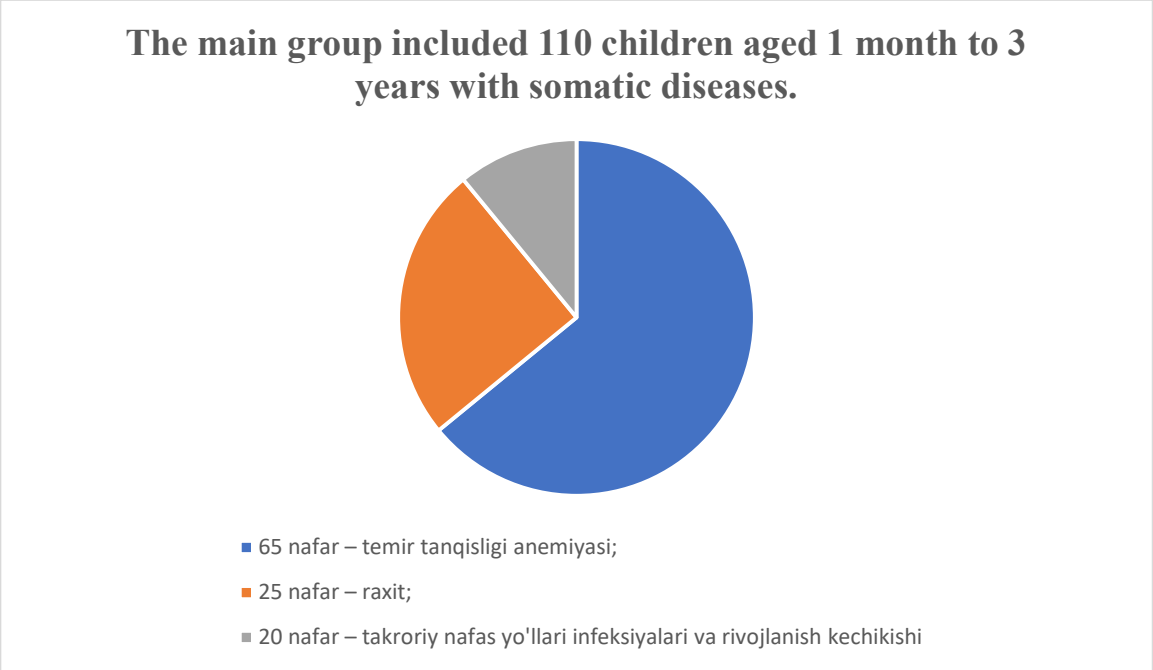
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determine the relationship between deficiency or excess and the severity of the disease.

Specific objectives:

1. Comparing element levels in patient and control groups.
2. To determine the correlation of deficiency with anemia, rickets, and immune disorders.
3. Evaluation of the significance of Ca/P ratio disorders in rickets.
4. Develop recommendations for prevention and treatment.

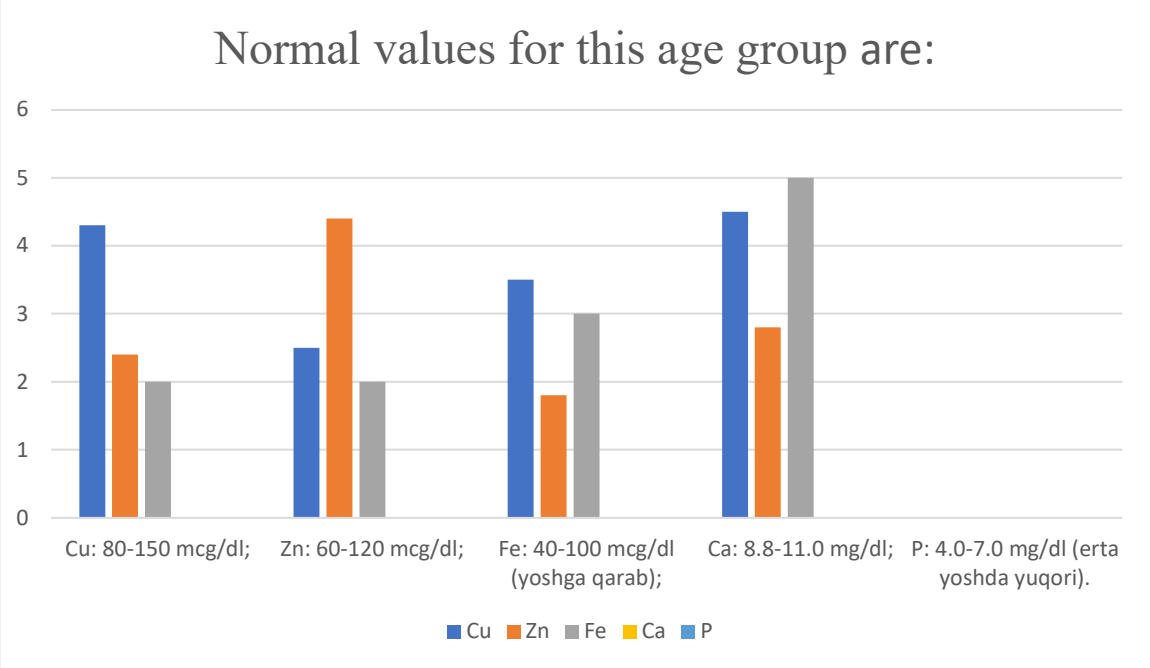
MATERIALS AND METHODS: The study was conducted in children's clinics in Tashkent in 2024-2025:



Pic-1

Control group – 50 healthy children of the same age. Patients were selected based on clinical diagnostic criteria (WHO and Uzbek SSV recommendations). Serum Cu, Zn, Fe, Ca and P levels were determined by atomic absorption spectrophotometry.

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Pic-2

Results The following changes were found in the affected children (Table 1):

Table 1

Element	Patients (n=110, mean ± SD)	Control (n=50, mean ± SD)	p-value	Deficiency/excess (%) in patients
Copper (Cu, mcg/dl)	148 ± 32	102 ± 18	<0.001	Excess – 72%
Zinc (Zn, mcg/dl)	58 ± 22	95 ± 16	<0.001	Shortage – 85%
Iron (Fe, mcg/dl)	38 ± 19	88 ± 20	<0.001	Shortage – 80%
Calcium (Ca, mg/dl)	8.1 ± 1.0	10.2 ± 0.7	<0.01	Shortage – 65%
Phosphorus (P, mg/dl)	6.1 ± 1.2	5.0 ± 0.8	<0.05	Excess – 62% (average Ca/P ratio 1.33, normal 1.8-2.5)

Additional analysis:

- Zn deficiency had a strong negative correlation with anemia severity (hemoglobin level) ($r = -0.78$, $p < 0.001$).
- Decreased Ca and increased P are associated with clinical signs of rickets (softening of the skull bones, bowing of the legs) ($r = -0.71$, $p < 0.01$).
- Cu excess has been identified as a factor that exacerbates Zn and Fe deficiencies (antagonistic effect).

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• In the 1-12 month group, Fe and Zn deficiency was more than 90%, while Ca/P disorders were more common in the 1-3 year group.

DISCUSSION: The results obtained are fully consistent with international and national scientific literature and once again confirm the role of micro- and macronutrient deficiencies in the development of somatic diseases in early childhood (from 1 month to 3 years). In particular, a high level of zinc (Zn) deficiency (85%) in sick children can lead to a decrease in the immune system and an increased susceptibility to recurrent infections, which, as noted in global studies, is associated with a deficiency of Zn, Fe and vitamin A in more than half of children under five years of age. The negative correlation of Zn levels with the severity of anemia in our study (r = -0.78) is similar to the results of a study conducted in Sweden, which showed that the amount of iron and zinc in the diet in children 6-11 months of age is directly related to the level of hemoglobin. In addition, iron (Fe) deficiency (80%) was identified as the main cause of iron deficiency anemia, which is explained by the high iron requirement in premature infants and the imbalance in breast milk or formula feeding. These results are consistent with the narrative review emphasizing the need for iron, zinc, and calcium deficiencies in preterm infants.

CONCLUSION. The main objective of this study was to study the role of micro- and macroelements of copper (Cu), zinc (Zn), iron (Fe), calcium (Ca) and phosphorus (P) in the development of somatic diseases (iron deficiency anemia, rickets, chronic respiratory infections and developmental delay) in children aged 1 month to 3 years, to assess their levels in the blood serum and to determine the relationship between deficiency or excess and the severity of the disease. The results obtained indicate that this goal was fully achieved and allowed us to draw the following important conclusions:

1. Zinc (Zn) and iron (Fe) deficiencies were high in affected children (85% and 80%, respectively), which were strongly correlated with anemia and immune dysfunction (r = -0.78). These results are consistent with global statistics (more than 50% of children under five years of age are deficient in Zn and Fe) and studies showing that dietary iron intake is associated with hemoglobin.

2. Calcium (Ca) deficiency and phosphorus (P) excess resulted in a Ca/P ratio disturbance (mean 1.33), which was highly correlated with rickets symptoms (r = -0.71). These changes are supported by studies investigating the role of Ca, P, and Zn in bone mineralization and show similar deficiencies in preterm infants.

3. Copper (Cu) excess (72%) was identified as a factor aggravating Zn and Fe deficiency, which is explained by the antagonism of the elements observed in chronic somatic conditions (e.g., transplantation).

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4. The study results align with studies highlighting the effectiveness of micronutrient enrichment in special feeding regimens and complementary feeding in the first 1,000 days of life, contributing to the solution of a global problem in preschool children.

Based on the information obtained, the following practical recommendations are made:

- Introduction of mandatory micronutrient (Zn, Fe, Ca, P, Cu) monitoring in polyclinics for somatic diseases in early childhood;
- When deficiencies are identified, individual correction (nutritional fortification, drug treatment) should be carried out, especially in the case of breast milk and complementary feeding;
- Strengthening national child nutrition programs in Uzbekistan, increasing the consumption of vegetables and fruits, milk and meat;
- Develop prevention strategies based on the latest guidelines on essential micronutrients for children and adolescents.

Future studies should focus on the long-term effects of micronutrient supplementation, regional nutritional characteristics, and element dynamics in new somatic states (e.g., lactation). Thus, this work has proven the scientifically sound importance of micronutrients in the prevention and treatment of somatic diseases in early childhood and has made an important contribution to pediatric practice.

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